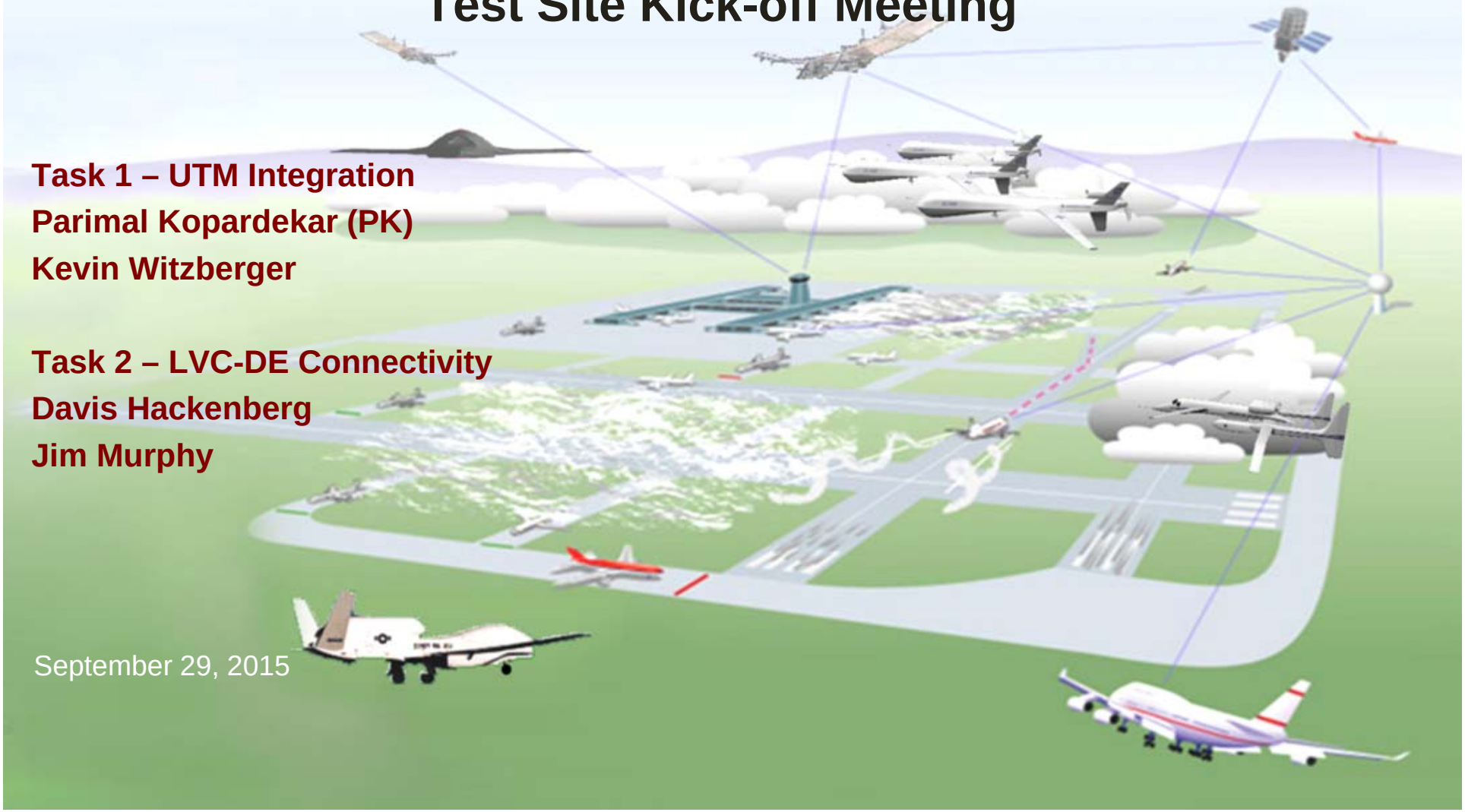
National Aeronautics and Space Administration

UAS Integration in the NAS Project
Test Site Kick-off Meeting



Task 1 – UTM Integration

Parimal Kopardekar (PK)
Kevin Witzberger

Task 2 – LVC-DE Connectivity

Davis Hackenberg
Jim Murphy

September 29, 2015

Overview

- Roll Call
  - UAS-NAS Project
  - UTM project
  - FAA
  - Alaska
  - Nevada
  - New York
  - North Dakota
  - Texas
  - Virginia
  - Other

- Congratulations to all on the Award!!!

- Opening Remarks
- IDIQ Overview
- Task 1 UTM Integration
  - UTM Overview
  - Task 1 Discussion
- Task 2 LVC-DE Prototype Connections
  - LVC Overview
  - Task 2 Discussion
- Test Site presentations and questions

IDIQ Overview

- Please submit all formal requests through, and copy the COR and CO on all relevant emails

- Administering Contracting Officer

Rosalia Toberman
rosalia.toberman-1@nasa.gov
661-276-3931

- Contracting Officer Representative

Davis Hackenberg
Davis.L.Hackenberg@nasa.gov
661-510-4832

- Task 1 Technical POC

Kevin Witzberger
Kevin.E.Witzberger@nasa.gov
650-604-2035

Joey Rios
joseph.l.rios@nasa.gov
650-604-0231

- Task 2 Technical POC

Jim Murphy
James.R.Murphy@nasa.gov
734-676-1164

IDIQ Overview

- Airworthiness (due one month after contract award)

As NASA and the FAA shall not be in operational control of the UAS operating at the Test Sites a clear declaration and understanding by each Test Site vendor needs to be clarified with the precise manner and processes in which each Test Site exercises their authority as a public entity in regards to airworthiness, safety, training, and operations of UAS operated within their Test Site. The contractor shall be responsible for operational oversight. That includes aircraft and crew certification and range safety.

The Test Site shall establish airworthiness, flight safety, mission readiness, and configuration control review processes and procedures to identify any hazards, to manage the risks associated with flight programs, to ensure safe flight operations, to manage and thoroughly document aircraft configurations, and to ensure that flight objectives satisfy programmatic requirements.(NPR 7900-003)

The Test Site shall be responsible to delineate specifically under whose public use authority that each Test Site's UASs shall be operated under, as part of their technical approach. The Test Sites are expected to operate under their own public use authority, and not that of NASA's. This information is needed to determine the operator's understanding of the SOW requirements to ensure the quality of deliverables as well as the processes and authority for complying with federal regulations for the performance of government flight activities.

The Test Site shall submit their documents that address current or planned airworthiness processes and other associated documentation that addresses operational control plans and incident response for NASA Review. [30 days after contract award]

IDIQ Overview

- IT Security Plan (due one month after contract award)
- Intent of initial deliverable: Ensure all test sites have:
  - A base level of IT security process followed are their facilities
  - An understanding of NASA's IT security requirements
  - Common understand for the use of data between the test site and NASA
- Initial deliverable does not cover the anticipated connection to be developed between each Test Site and NASA. This will be determined based on the proposed system architecture and specific data interface requirements
  - A direct connection between a Test Site facility and NASA will require an Authority to Operate (ATO)
    - Negotiated between the Test Site and NASA
    - This initial IT Security Plan is a subset of the required documentation
  - ATO deliverable 3/31/2016

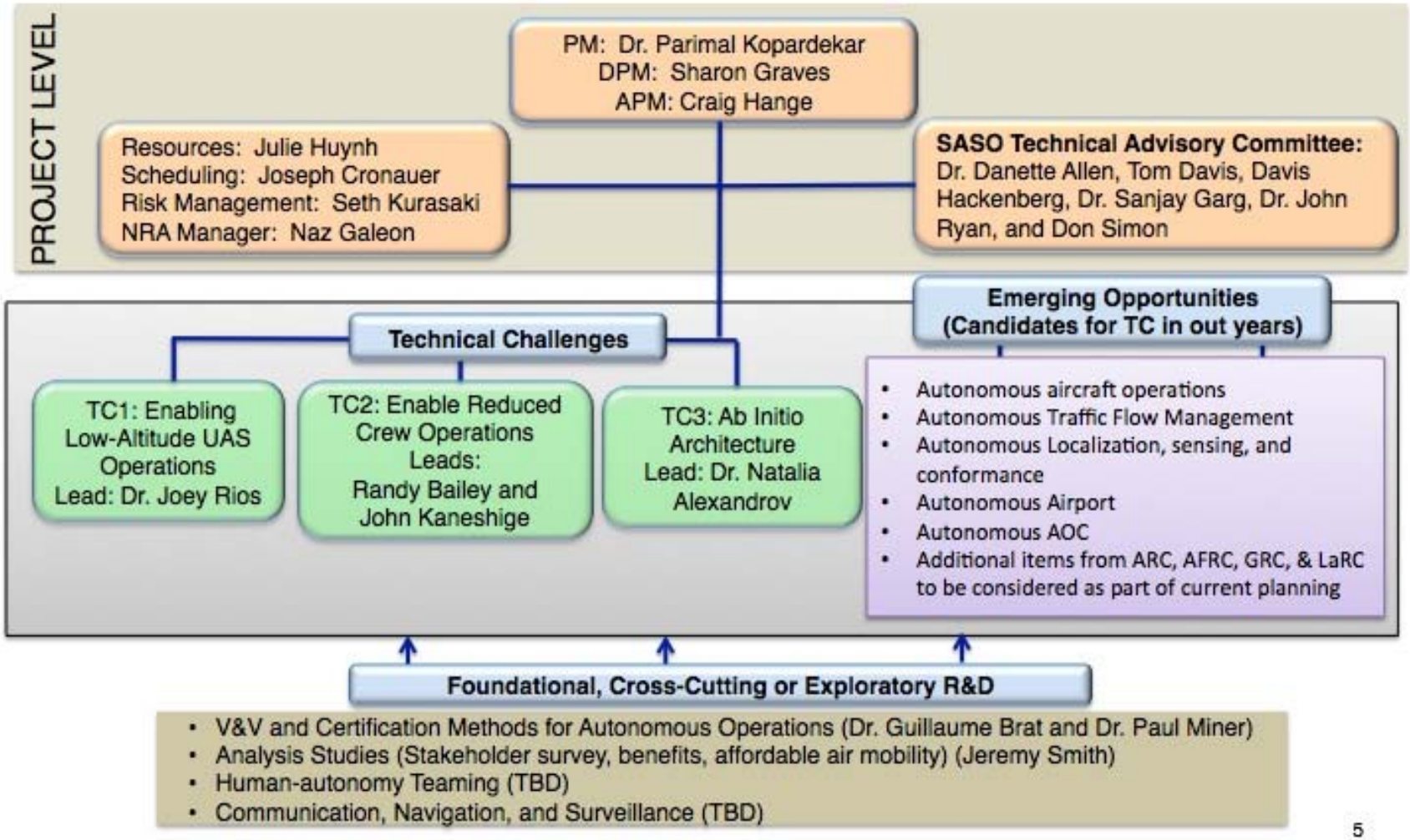
IDIQ Deliverable Dates

Test Site Deliverable Schedule						
Test Site	**Deliverable**	**Deliverable Instructions**	**Deliverable Due Date**	**Received Date**	**KN Link**	**Notes**
Alaska - Awarded 09/03/2015						
	Alaska IT Security Plan		10/3/15			
	Alaska Airworthiness		10/3/15			
Nevada - Awarded 08/24/2015						
	Nevada IT Security Plan		9/23/15			
	Nevada Airworthiness		9/23/15			
New York - Awarded 09/01/2015						
	New York IT Security Plan		10/1/15			
	New York Airworthiness		10/1/15	9/29/15		Rosalia sent to Brad Neal on 09/9
North Dakota - Awarded 09/08/2015						
	North Dakota IT Security Plan		10/8/15			
	North Dakota Airworthiness		10/8/15			
Texas - Awarded 08/21/2015						
	Texas IT Security Plan		9/20/15			
	Texas Airworthiness		9/20/15	9/18/15		Rosalia sent to Brad Neal on 09/23
Virginia - Awarded 09/02/2015						
	Virginia IT Security Plan		10/2/15			
	Virginia Airworthiness		10/2/15			

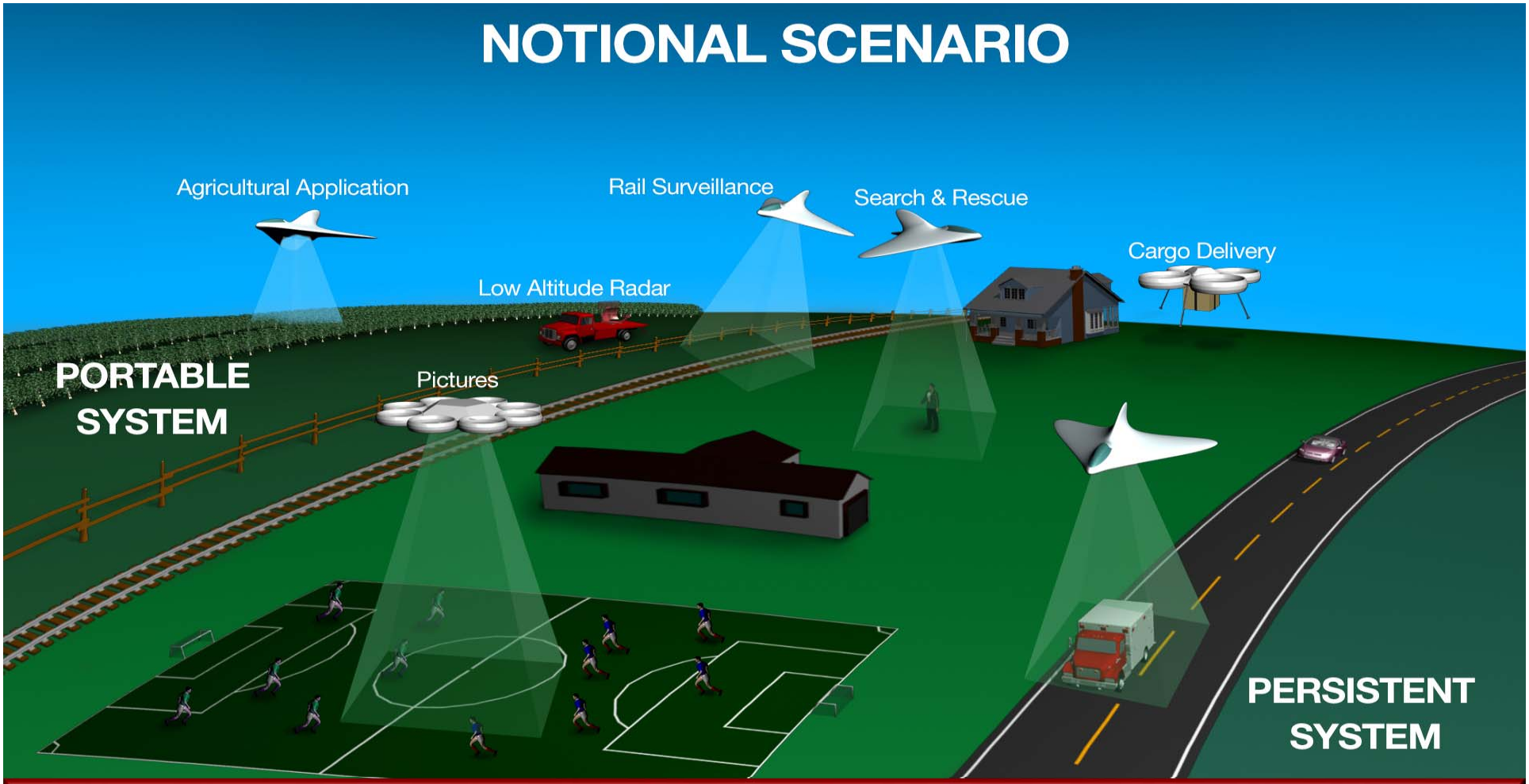
POC's

Test Site Distribution List as of 09.23.15				
University of Alaska Fairbanks				
Name	**Title**	**Email**	**Phone**	**Notes**
Ro Bailey*	Director: Pan-Pacific UAS Test Range Complex and Associate Director: Alaska Center for Unmanned Aircraft Systems Integration - RDT&E	Rbailey11@alaska.edu	(mobile) 907-322-2255	
Catherine Cahill	Management of Alaska Center Unmanned Aircraft Systems Integration (ACUASI)	cfcahill@alaska.edu		Request came from Rosemary Madnick on September 22nd via a memorandum requesting replacement of Marty Rogers.
Rosemary Madnick	Grants and Contracts Administration	rmadnick@alaska.edu	(mobile) 907-474-6446	
State of Nevada				
Name	**Title**	**Email**		**Notes**
Thomas Wilczek*	Defense and Aerospace Industry Representative; Governor's Office of Economic Development	tawilczek@diversifynevada.com	757-687-9900	
Michelle Schierholt	Executive Assistant; Nevada Governors Office	mschierholt@diversifynevada.com	757-687-9900	
New York - Oneida County (Griffiss UAS Test Site)				
Name	**Title**	**Email**		**Notes**
Chad Lawrence	Deputy Commissioner of Aviation	Clawrence@ocgov.net	702-525-1562	
Dr. Raymond Young	Technical Director	ryoung@nuair.org	702-525-1562	
Nothern Plains UAS Test Site North Dakota				
Name	**Title**	**Email**		**Notes**
Robert J Becklund*	Executive Director; Northern Plains Unmanned Aircraft Systems Test Site	rbecklund@nd.gov	701-777-6330	
Paul Lucy	Director: Economic Development & Finance at North Dakota	plucy@nd.gov	701-328-5388	
Brian Opp	Manager, Aerospace Development: North Dakota Department of Commerce	blopp@nd.gov	701-325-5342	
Texas A&M University - Corpus Christi				
Name	**Title**	**Email**		**Notes**
Luis Cifuentes, Ph.D. *	Vice President for Research, Commercialization and Outreach; Acting Executive Director of the Lone Star UAS Center of Excellence and Innovation	luis.cifuentes@tamucc.edu		
Dr. Mayra Hough	Contracts	mayra.hough@tamucc.edu	361-825-3882	
Dr. Melanie Neely Willis	Technical	mneelywillis@camber.com	361-825-4120	
Ms. Lori Blades	Pricing	lori.blades@tamucc.edu	301-825-2896	
Dr. Chris Walach	Director of Technical Operations, NIAS-Nevada	chris.walach@nias-uas.com		Requested to be added 09.22 via email to Davis
Virginia Tech				
Name	**Title**	**Email**		**Notes**
John Rudd*	Assistant Vice President for Sponsored Programs Administration	ruddj@vt.edu	540-231-5281	
John Greene	Technical	greenej@vt.edu	540-231-8566	
Emilee Hillman	Commercial Contracting Program Coordinator	eande06@vt.edu	540-231-2593	

Safe and Autonomous System Operations (SASO) Organizational Structure

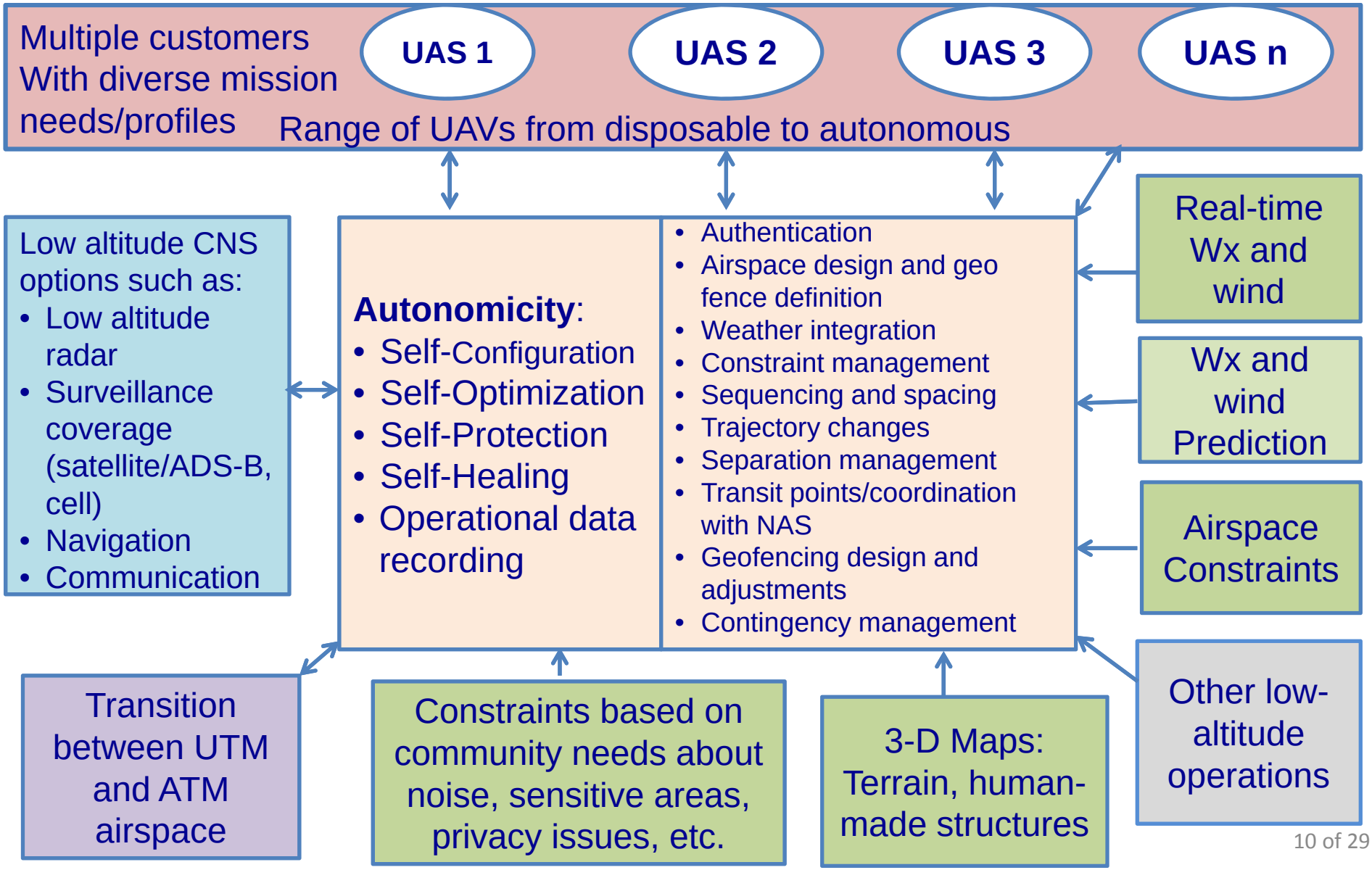


UTM Applications



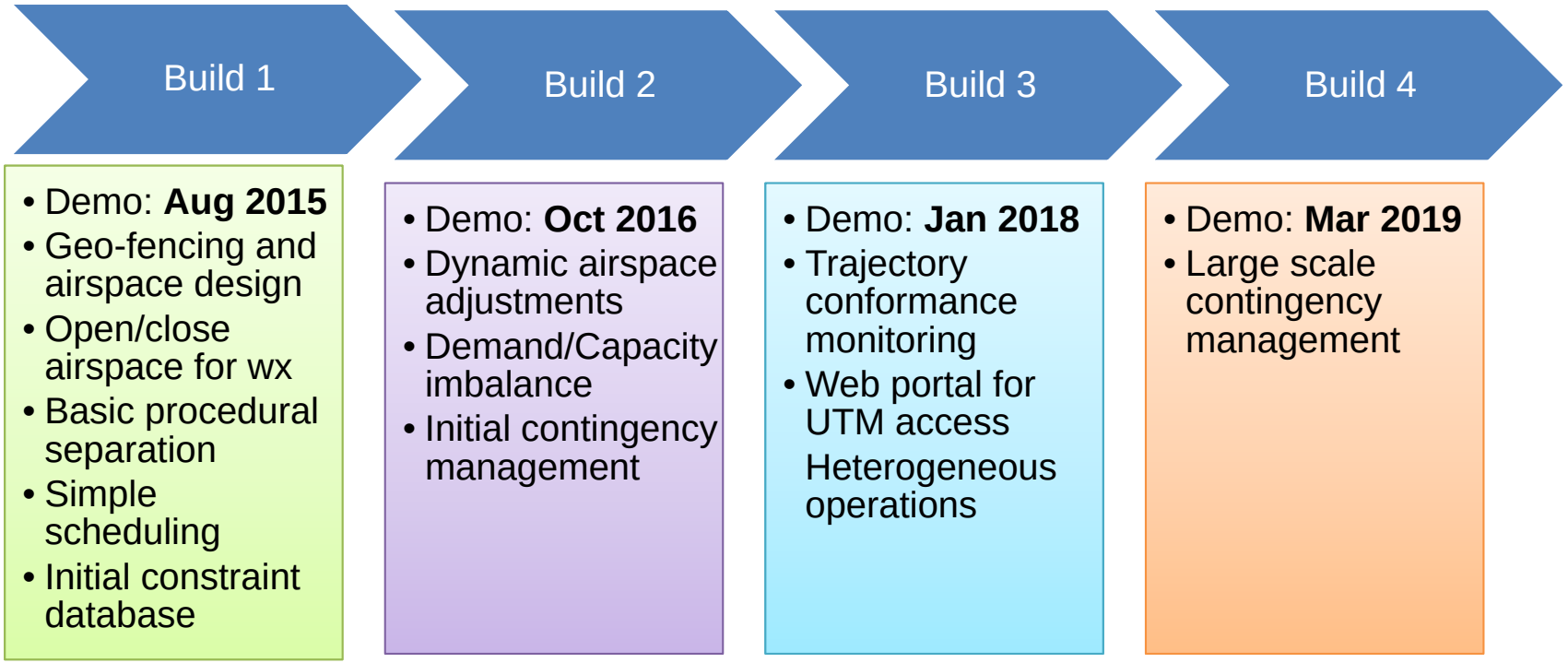
- **Near-term Goal** – Enable initial low-altitude airspace and UAS operations with demonstrated safety as early as possible, within 5 years
- **Long-term Goal** – Accommodate increased UAS operations with highest safety, efficiency, and capacity as much autonomously as possible (10-15 years)

UTM – One Design Option – Towards Autonomy



Schedule

- UTM research and development driven by various “Builds”
- Each Build adds more services and capabilities



UAS Traffic Management Build 1 Flight Demonstration: Overview

NASA Ames Research Center

09/29/2015

Partnerships

UTM Vehicles










Equipment

- Ground Equipment
  - Air Traffic Surveillance
    - (ADS-B, ASDE-X, air traffic radar)
  - Radar Station
    - SRHawk 2D low altitude radar
  - 1 ADS-B Ground Relay Station
  - Sound Microphone Sensors
  - Weather Station
    - 100 ft Weather Tower
    - Radiosonde System
    - Microwave Profiler
- Vehicles:
  - Multi-rotors:
    - 5 QuadCopters
    - 1 Hexacopter
    - 2 Octocopters
  - Fixed Wing : 2
  - Range in size, weight, endurance, and capabilities
  - 1 ADS equipped aircraft
  - 1 vehicle equipped to be tracked over cellular network
  - UTM Connection via LAN
- UTM Manager displays

Test Objectives

- **Objective 1:** Demonstrate UTM Capabilities
  - Show connection of a variety of vehicles to the UTM sytem
- **Objective 2:** Collect Data on UAS Navigation Performance Error
  - Collect data on a vehicles ability to track a flight plan and maintain a geo-fenced boundary
- **Objective 3:** Collect Data on Aircraft Tracking Performance
  - Collect data on the ability and performance of a independent surveillance source to track the UAS
- **Objective 4:** Collect Weather Observations for Forecasting Models
  - Collect localized weather information and compare them to forecasting models and support the development of vehicle performance models
- **Objective 5:** Collect Data on Noise Signature of UAS Vehicles
  - Collect data on the decibel levels and frequencies at which UAS operating at different altitudes will produce in an operational environment.

Flight Plan

Altitudes:

- Launches will occur at local airfield elevation (approx. 166 ft. MSL)
- Maximum flight altitudes up to 400 ft. AGL

Range:

- Flights to remain within MOA airspace constraints & site layout operational area (see next slide).
- Flights will be staged over terrain which consists of the airfield runways & unpopulated farm land.

Duration:

- Eight (8) to thirty (30) minutes on average, not to exceed safe battery limits.

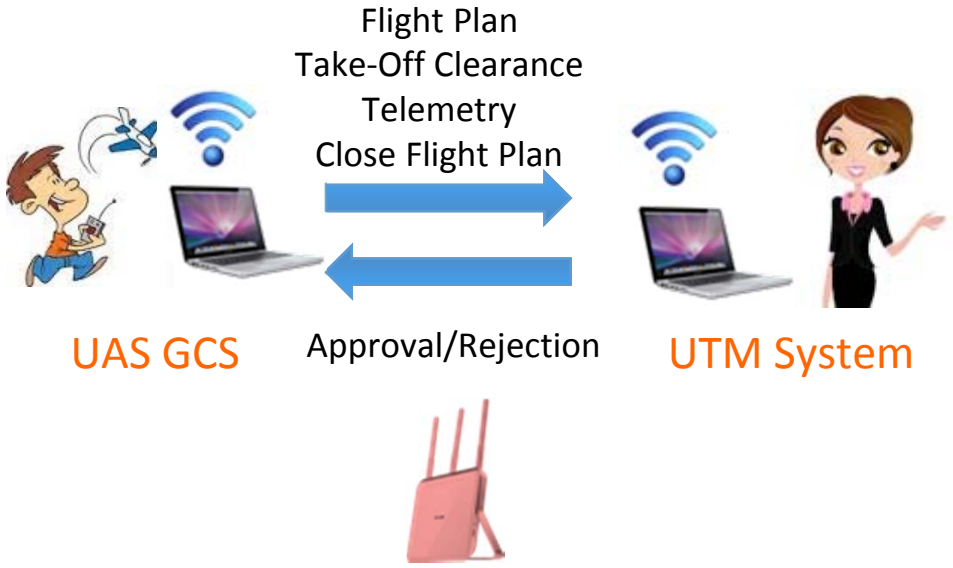
Modes:

- Single aircraft launch & recovery
- Dual aircraft launch & recovery

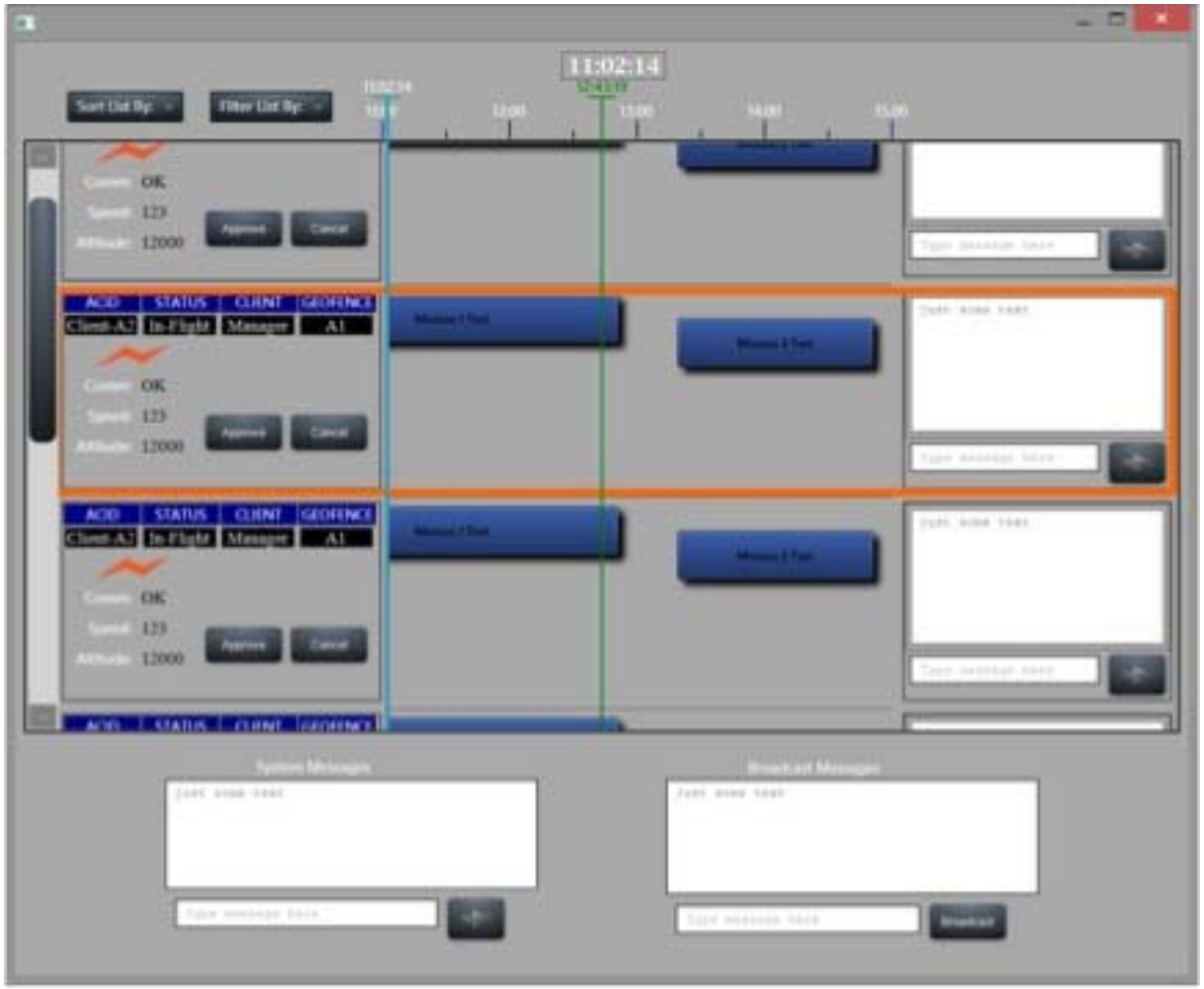

Crow's Landing
08/24/2015-09/02/2015
Legend
ADS-B Relay Station
Field Operations Canopy
Ground Control Station #1
Ground Control Station #2
Latrines
LSTAR Radar
Microphone
Parking
Rest Area
SRHawk Radar
UTM Canopy
Video Station
Weather Equipment
Davis Rd
W Ike Crow Rd
Bell Rd
Google earth
N

Connection to the UTM System

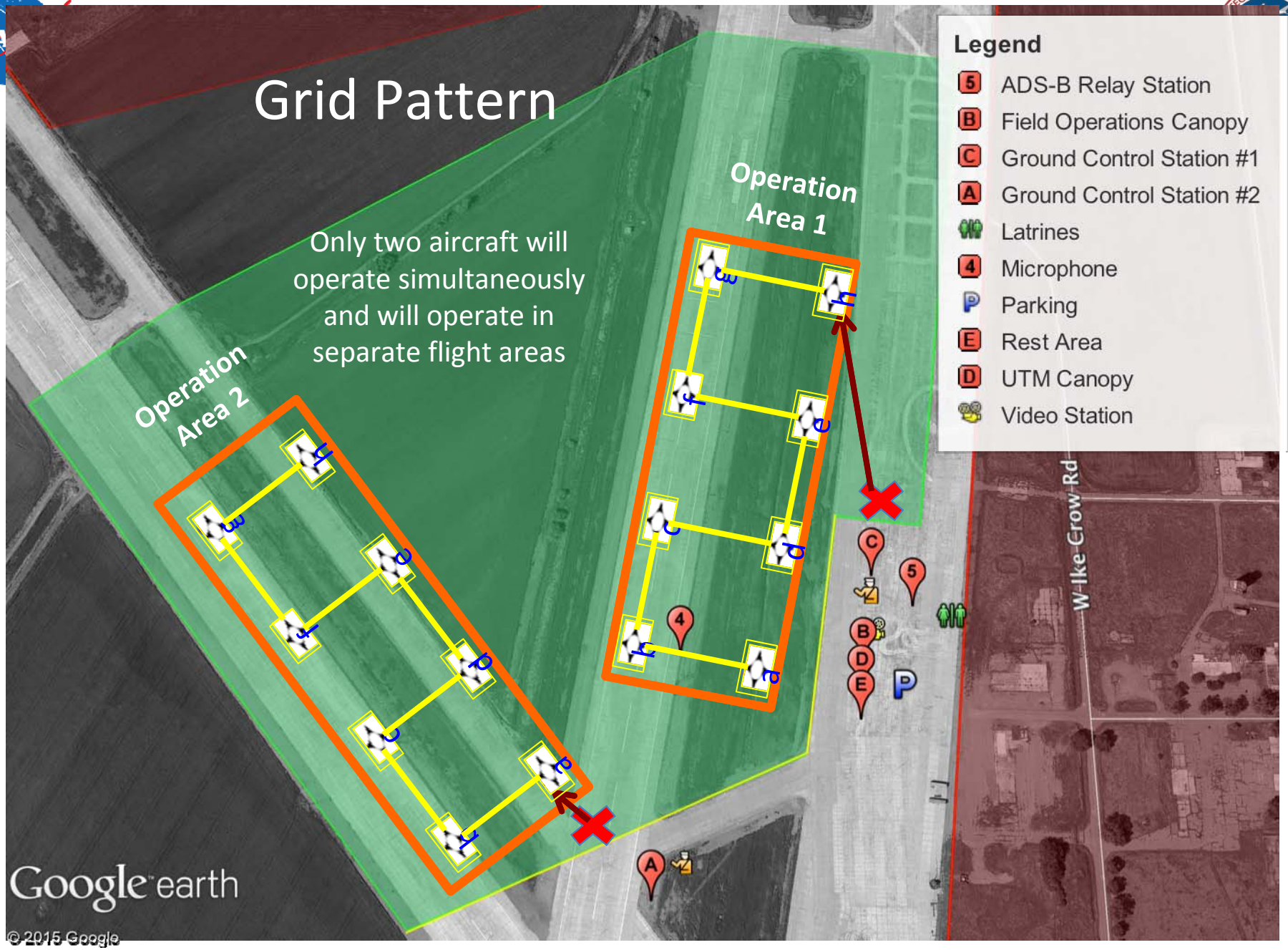
- Communication between GCS & UTM system is over ad-hoc WiFi network (5.0GHz router)
  - Telemetry information is read-only from GCS
  - GCS can submit a flight plan to the UTM system & UTM system can respond with an approval or rejection message to the GCS.



UTM Manager Display



Grid Pattern



Task 1 Qualitative (Fuzzy) Goals

From the UTM effort's perspective, there are several ways we see value being generated for our project.

These high-level goals are more qualitative and not hard requirements indicating the technical success of this Task 1.

- Exercise the UTM prototype
- Introduce Test Sites to UTM concept and use
- Shakeout prototype technical issues
- Pave way for potential future collaborations
- Test architecture options for UTM

Exercise the UTM prototype

- Use several new clients
- Test system under geographic diversity

Introduce Test Sites to UTM concept and use

- Leverage capabilities of test sites
- Obtain feedback (formal and informal) on UTM concept from experts in the field

Shakeout prototype technical issues

- Data exchange formats
- Manager implementation
- Connectivity

Pave way for potential future collaborations

- Make it easier to work with test sites in various capacities
- No guarantees

Task 1 Qualitative Goals

Test architecture options for UTM

- How do multiple UTM Systems interact?
- How well can a monolithic version of UTM handle geographic diversity?

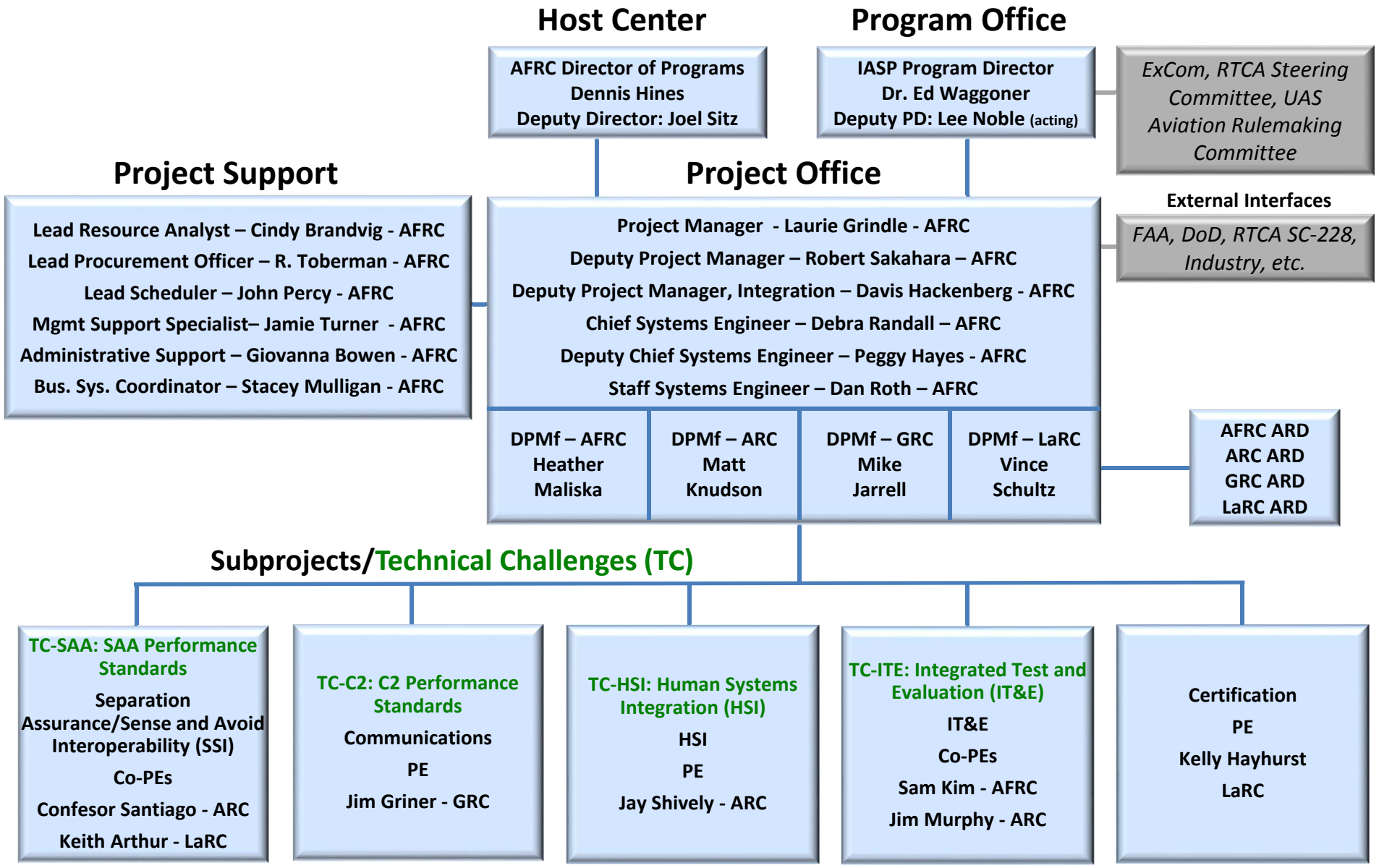
Demo Notes

- Test sites will conduct roughly independent shakedown tests (with and without flights) through the end of Feb 2016
- In April 2016, we will attempt a coordinated demonstration wherein each site is executing flights under UTM simultaneously
- We will test at least two UTM architectures during the coordinated demo: monolithic UTM, and separate UTMs

Task 1 Deliverables

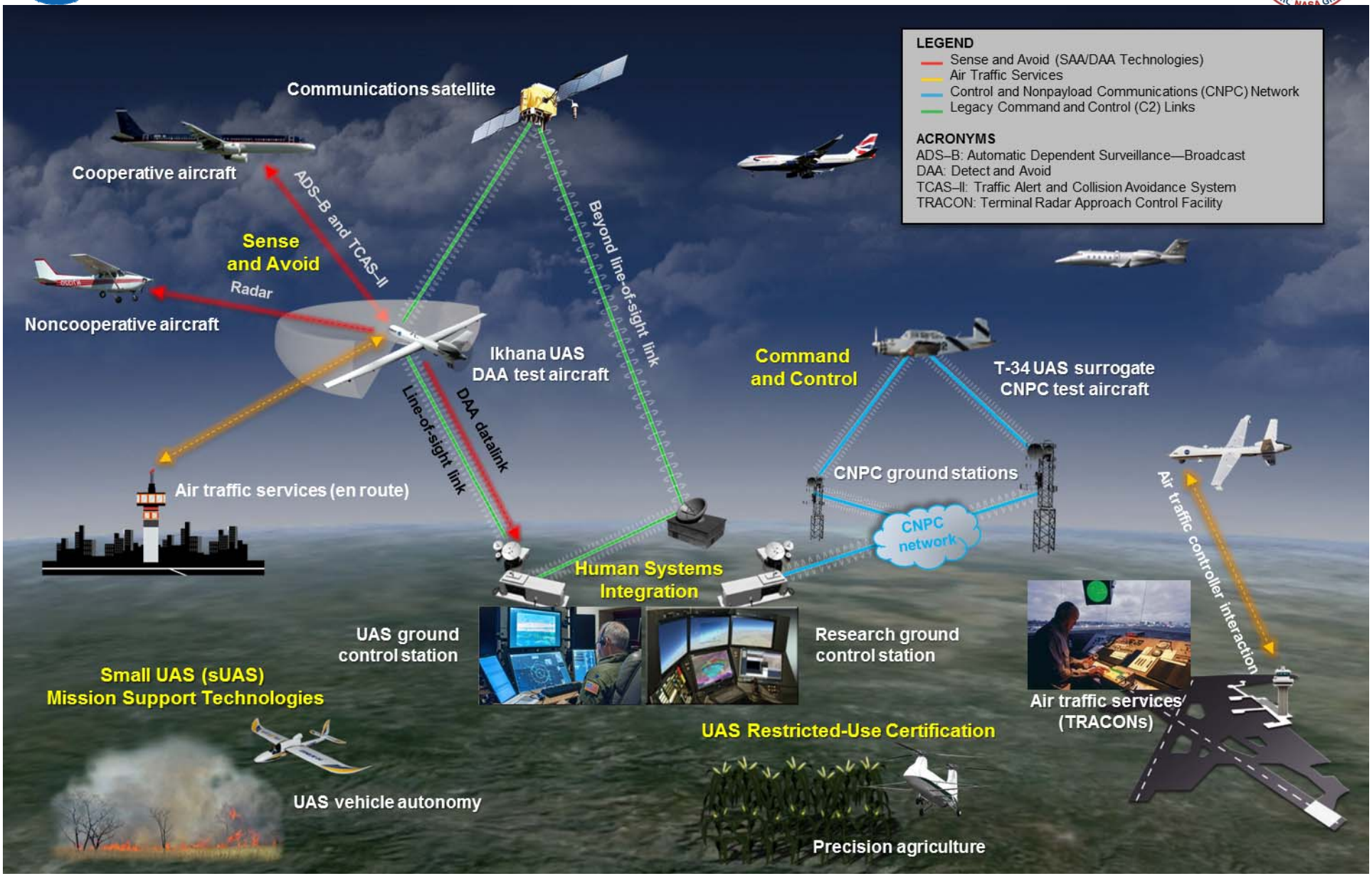
Task 1 (All Test Sites) POP through 05/31/2016			
	Joint Kick-off Meeting	Each Test Site will plan for a joint kick-off meeting	9/30/15
	Task 1 Test Plan	Each Test Site shall submit a test plan to accomplish the goals of the task. The test Plan shall include content described in the SOW	10/31/15
	Shakedown tests	Each test site shall conduct a UTM shakedown activity with multiple aircraft as a precursor to Initial Safe National UAS integration Campaign/Initiative	09/30/2015-02/29/2016
	Task 1 Safe Integration Month Demo	Each test site shall conduct a UTM demo with multiple aircraft in conjunction with Initial Safe National UAS integration Campaign/Initiative	4/30/16
	Task 1 Final Report	Each Test Site shall submit a report on the simultaneous UTM demonstration per content described in Task 1	5/31/16

UAS Integration in the NAS Organizational Structure



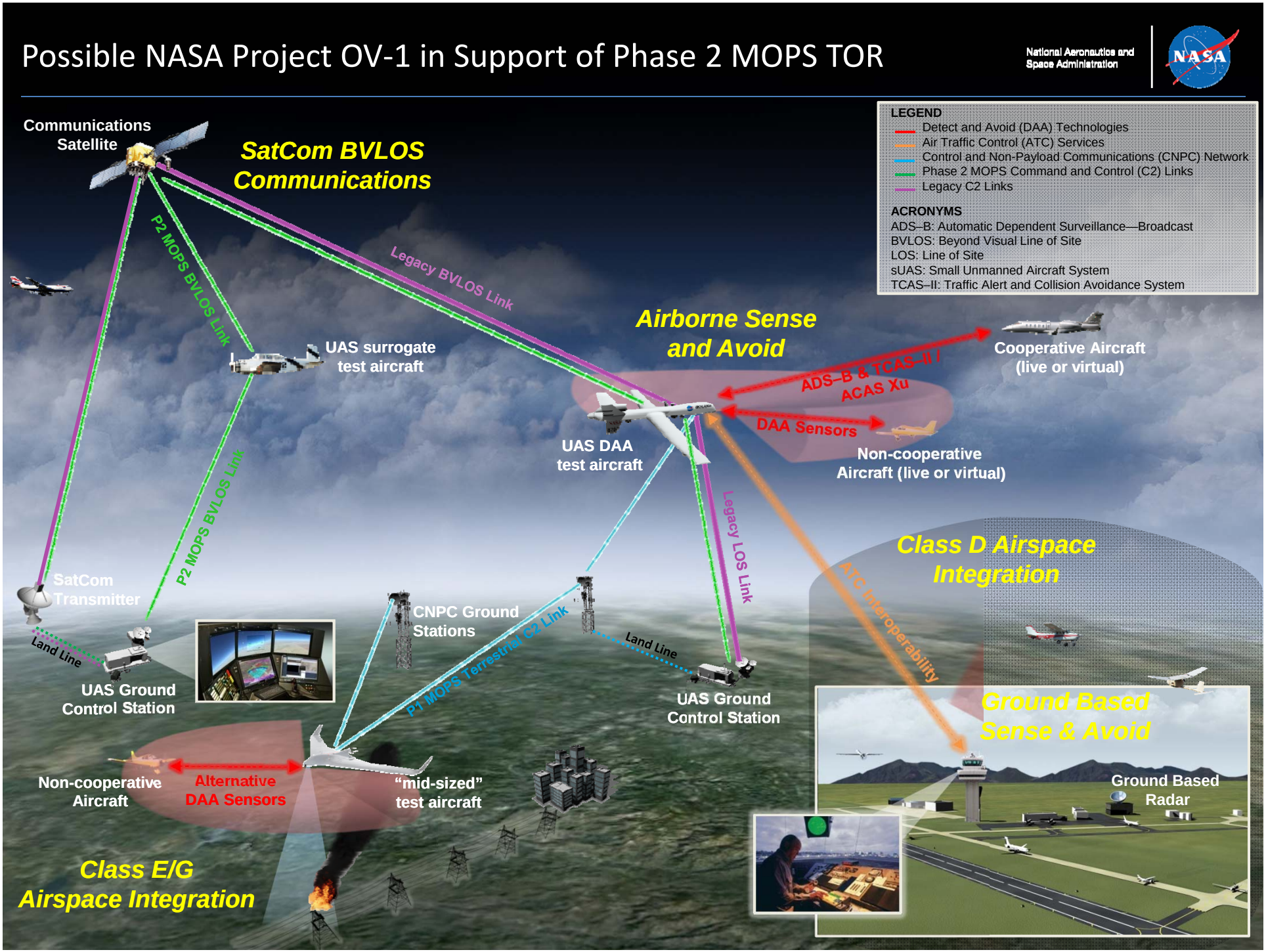
PE: Project Engineer, DPMf: Deputy Project Manager for

UAS-NAS Project OV-1 in support of P1 MOPS

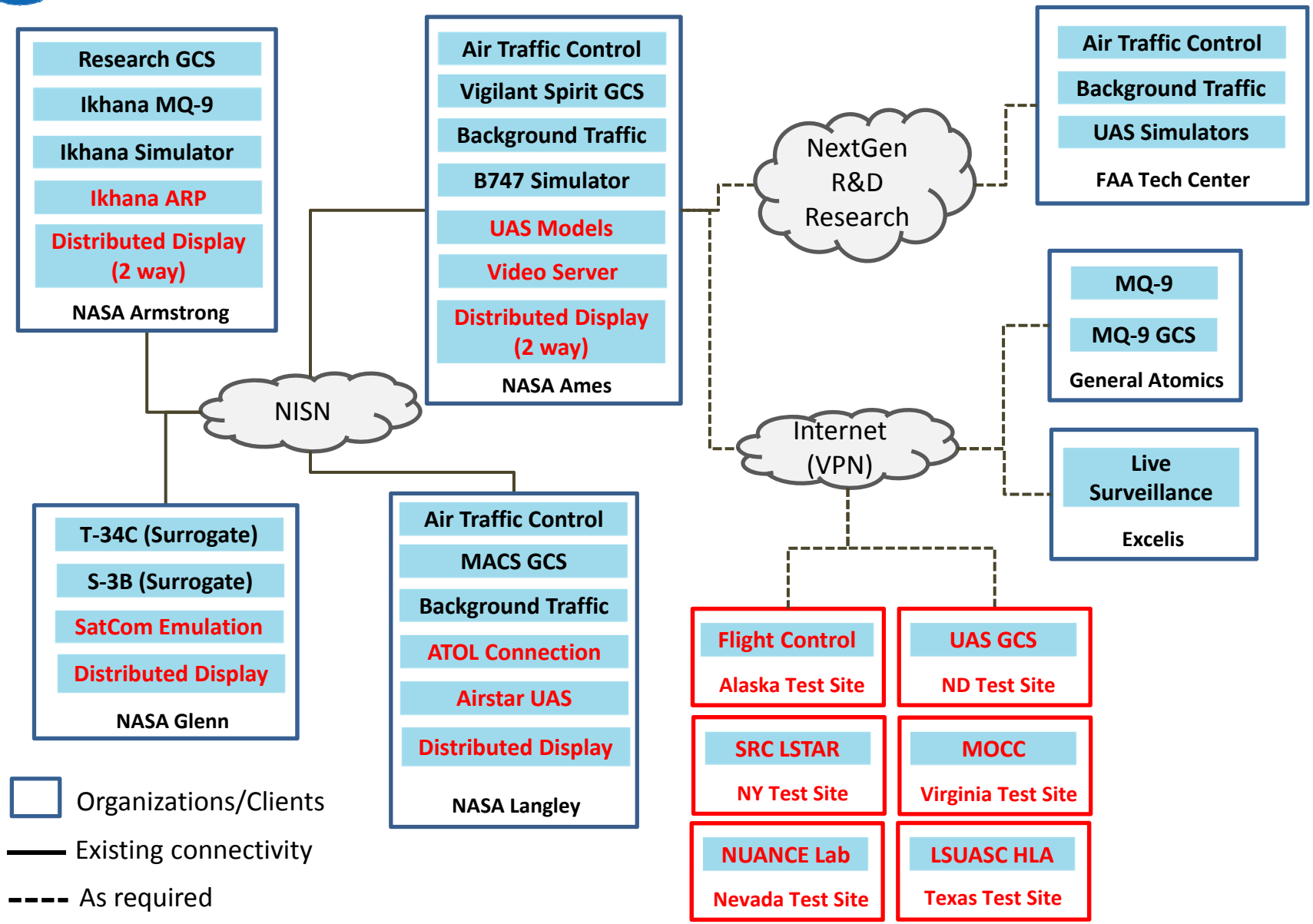


Possible NASA Project OV-1 in Support of Phase 2 MOPS TOR

National Aeronautics and Space Administration



UAS-NAS LVC-DE Build (including Augmentation Funding)



LVC Client Assets

- Live
  - Ikhana (NASA's MQ-9)
  - T-34C (Manned Intruder)
  - S-3B Viking (Surrogate UAS)
- Virtual
  - Ikhana Sim
  - B747 Flight Simulator
  - Ground Control Station
  - Multi-Aircraft Control System (MACS) ATC Emulator
- Constructive
  - MACS Pseudo Pilot



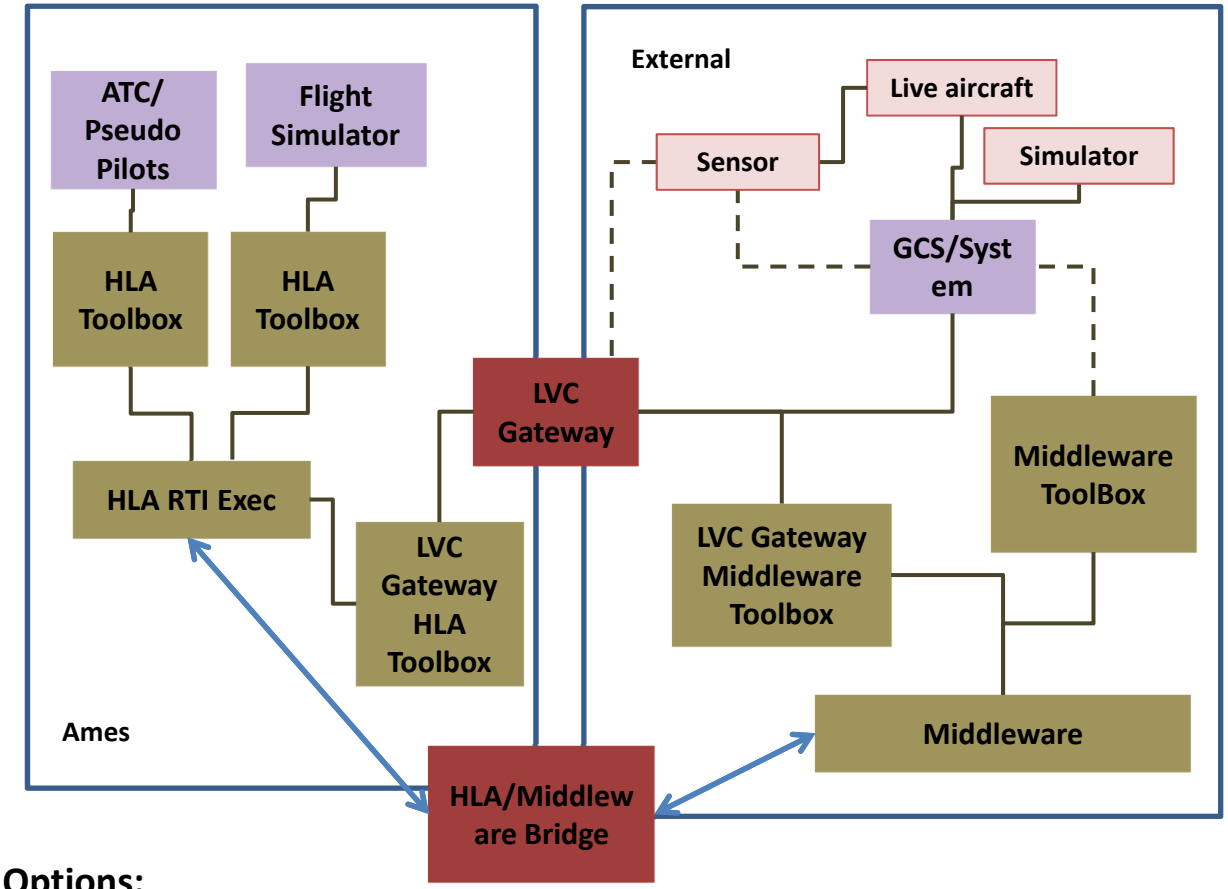





Task 2 Overview

- Connect to the LVC-DE!

LVC Gateway Bridge Connection



Options:

1. **Connect to LVC Gateway**
   - Direct connection to local LVC Gateway
   - Direct Connection to remote LVC Gateway
2. **Leverage existing Test Site Middleware**
   - Connect Middleware to LVC Gateway
   - Develop Bridge between middleware and LVC HLA

Tasks:

- **Identify candidate test**
  - Required equipment
  - Support systems
- **Determine system architecture**
  - Start Connection Agreement paperwork
- **Setup LVC Gateway at local facility (if required)**
  - Sign LVC Gateway SUA and receive software
  - Procure/identify LVC Gateway hardware
  - Install gateway
- **Identify Interface**
  - Work with LVC Team to integrate ICD changes into existing LVC system
- **Establish connection**
- **Test**

Task 2 Deliverables

Task 2 (All Test Sites) - POP through 09/30/2016			
	Joint Kick-off Meeting	Each Test Site will plan for a joint kick-off meeting	10/31/15
	Proof of Hardware purchases	Documentation of equipment to be installed for LVC-DE connection	12/31/15
	Software Usage Agreement	Final signed software usage agreement necessary for connection to LVC	3/31/16
	Authority to Operate (ATO)	Final signed ATO necessary for connection to LVC	3/31/16
	Initial Safe National UAS Integration Initiative Testing	Initial Testing of LVC system connectivity during the timeframe of an independent NASA initiative.	4/30/16
	Final LVC-DE Connection	Final Demonstration of all LVC-DE, likely a multiple week period. Live flight data will be passed to NASA from the vehicle system through the LVC	07/31-08/31/2016
	LVC-DE ICD Gap Assessment	Description of deficiencies or necessary changes to NASA ICD to allow for more efficient connections, and to document final configuration ICD	9/30/16

BACK-UP

Proposed SMART NAS Project Structure